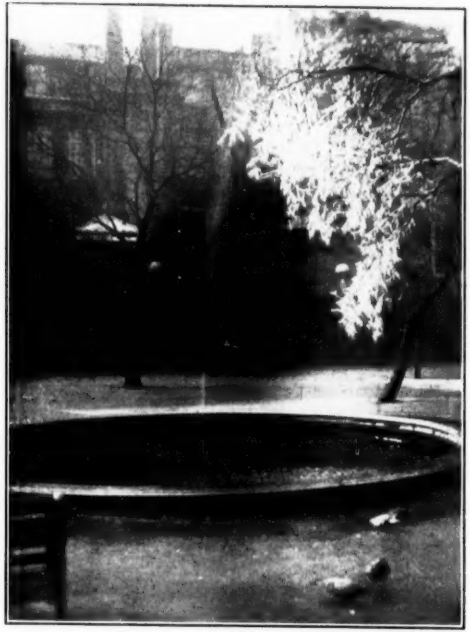

FOUNTAIN COURT, LONDON, E.C.4, MARCH 7TH, 1931, 1.20 P.M. (SEE PAGE 69).

M.O. 339.

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The Cold Spell and Snow of March, 1931

By W. R. MORGANS, M.Sc.

The severe frost and snow experienced in Great Britain during early March had actually started in Scotland on February 26th, and the incidence of the cold period in the south of England is mainly associated with the movement of an anticyclone originally centred over Greenland.

During the latter part of February, depressions to the north of Scotland moved north-east to Scandinavia, between anticyclones centred over Greenland and the Bay of Biscay, bringing in their rear a burst of cold air, which reduced considerably day temperatures throughout the country and in many parts of Scotland, brought them below freezing point. On February 27th a depression to the north of Scotland remained fairly stationary and deepened, while another over southern England moved rapidly eastwards, amalgamating with the former to form a complex depression over the Baltic by March 1st. Snow accompanied the passage of these depressions, and by February 28th and March 1st snow fell generally throughout the country. Dalwhinnie recorded snow drifts of 2 feet, Harrogate 4in. of snow lying and Croydon over 3in., while lightning and hail accompanied the falls in London. With the clearance, favourable to night radiation, in the rear of these depressions, screen and grass minimum temperatures were low generally during the nights of February 28th-March 1st and March 1st-2nd, the lowest

(93699) 107/27 1,075 4/31 M. & S. Gp.303

being 10°F. for the screen and 3°F. for the grass minima at Dalwhinnie.

Between March 2nd and 4th, the anticyclone over Greenland moved east and extended south, forming a ridge of high pressure over the North Sea and eastern Scotland. Severe cold and frost occurred during the extension of the anticyclonic ridge, especially over Scotland, where day temperatures in many parts were well below freezing point. The maximum temperature on the 4th was 26°F. at Dalwhinnie and 32°F. at Aberdeen; the screen and grass minimum temperatures at Aberdeen on the night of the 3rd-4th were 12°F. and 8°F. respectively.

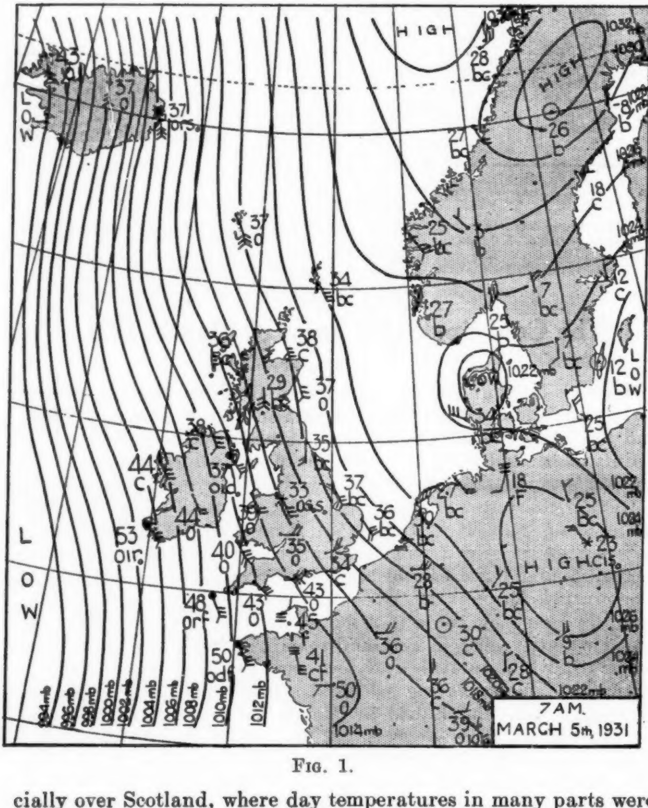


Fig. 1.

By the 5th, the Greenland anticyclone had become definitely established over Scandinavia and extended well into central Europe. Fig. 1 indicates the pressure distribution at 7h. on

March 5th, and shows a general current of south-easterly winds over Great Britain. Upper air temperatures taken at Duxford at 8h. and at Kjeller, Norway, at 10h. on the 5th are shown in Fig. 2, numbered (1) and (2), and it is seen that the upper air above Kjeller was much colder and had a much steeper lapse rate of temperature extending up to 15,000 feet than the air above Duxford on the same day. By the 8th, the Scandinavian anticyclone had moved west and built up off Iceland causing a

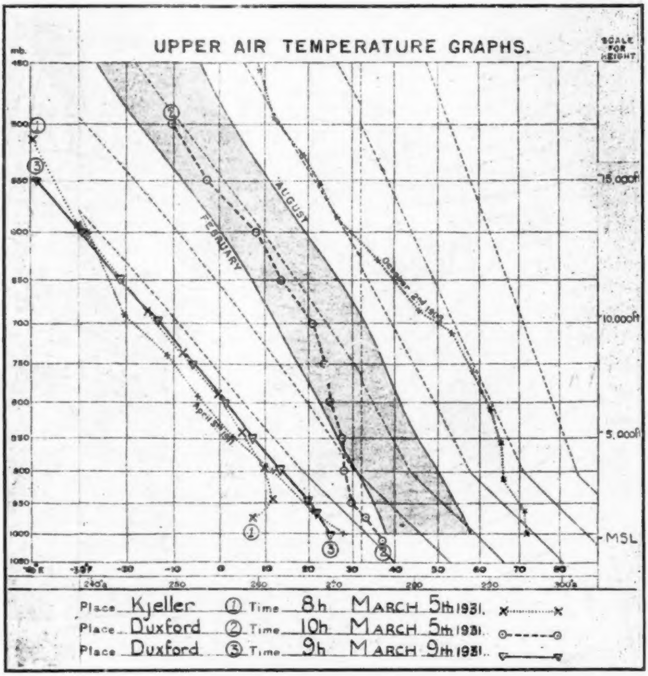


FIG. 2.

general sweep of easterly winds from Russia and Scandinavia across the British Isles. A synoptic chart showing the change in the position of the anticyclone by the 8th and the sweep of easterlies is shown in Fig. 3. An upper air temperature record taken at 9h. at Duxford on the 9th is also shown in Fig. 2 (3) and shows a marked fall of temperature of the upper air at Duxford, with a steep lapse rate of temperature closely comparable to that shown at Kjeller on the 5th. Moreover, from the upper air ascents, it is noticed that the cold air over Norway on the 5th was comparatively dry, but in its passage

across the North Sea it had absorbed moisture, so that the humidity was high in the lower layers when it arrived over England. It was this fact, coupled with the steep lapse rate of temperature in the upper air that gave rise to instability and the consequent heavy falls of snow in this country during early March.

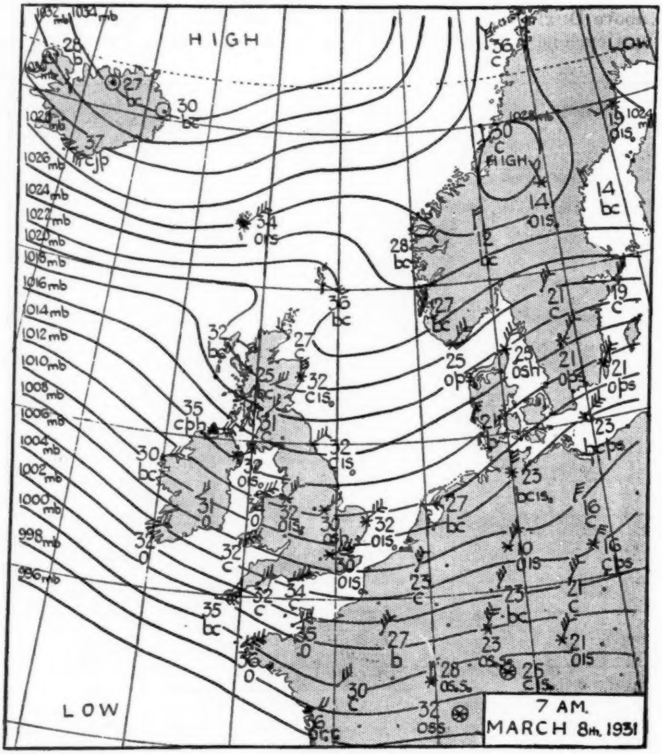


FIG. 3.

With the arrival of the cold air from northern Russia, snow fell generally throughout the country between the 6th and 10th, and kept day temperatures well below freezing point in many parts of the country for several days. On the 10th, the maximum temperature at Lympne was 27°F., and in many places in the south-east of England the maximum never exceeded 30°F. During this period some of the lowest screen minima recorded

on the night of the 9th-10th were 13°F. at South Farnborough, 14°F. at Bournemouth and Dungeness, and 15°F. at Winchester, and some of the lowest grass minima on the same night were −1°F. at Lympne, 1°F. at South Farnborough, 4°F. at Kew and Shoeburyness.

The further movement westward of the anticyclone to the north of Iceland with an extension southward, brought fresh northerly winds over Great Britain, and though temperatures still continued low there was a considerable rise in temperature by the 11th and 12th, compared with the preceding days. The really cold spell apart from ground frost at night had finished in England by the 12th, but it continued in Scotland well up to the 15th.

From the 18th to the 20th, an anticyclone maintained high pressure to the east of the British Isles causing southerly winds over the country. Day temperatures everywhere were high for the period of the year, a maximum of 69°F. being recorded at Cardington, 66°F. at South Farnborough and Kew on the 20th. Another extreme for the month was the screen minimum of 13°F. at South Farnborough on the night of the 9th-10th, indicating at Farnborough a range of 53°F. during the 10 days, 10th-20th.

It might be of advantage to compare the preceding upper air temperatures with others taken at Duxford and Linkoping, Sweden, during the cold spell in early March, 1928. The establishment of high pressure over Iceland caused an influx of cold air from north Russia and upper air temperatures taken at Linkoping at 7h. and at Duxford at 11h. on March 9th, 1928, showed extremely cold air, with a steep lapse rate of temperature at Linkoping and much warmer air at Duxford. At 12h., March 10th, the upper air ascent at Duxford indicated a decided fall in temperature and a lapse rate similar to that at Linkoping. During the onset of this cold air snow fell and severe frost occurred during the nights.

The low temperatures (in March, 1931) compare favourably with other low temperatures during the cold spells in March, 1917 and 1928. During March, 1917, the lowest temperatures occurred in Scotland during the night of the 8th-9th, when the sky was clear and the saddle between two depressions was over the east coast. The lowest minima in Scotland were −3°F. at Braemar, −2°F. at West Linton, 0°F. at Balmoral and in England, 8°F. at Alnwick Castle and 9°F. at Hereford. For the grass minima, Balmoral recorded −5°F., West Linton −2°F., Buxton 0°F. and Durham 4°F. On March 13th, 1928, screen minima of 11°F. occurred at Rhayader and East Anstey and 12°F. at Stogursey, and on the night of the 13th-14th a grass minimum of 3°F. occurred at Stogursey and 7°F. at Rhayader.

The South-west Monsoon Drought of 1929 over Ceylon

By H. JAMESON, M.Sc., F.Inst.P.

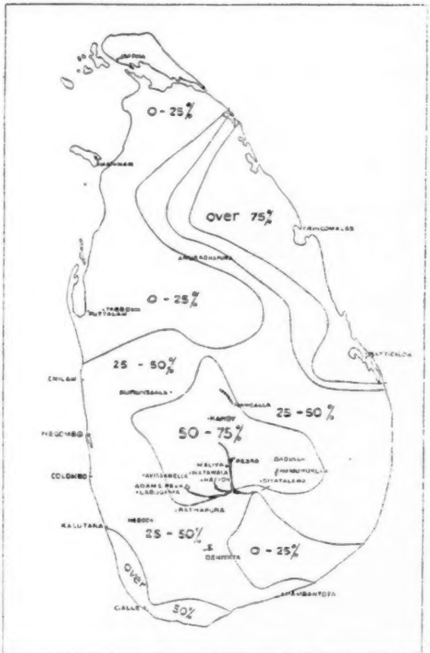
There are two well-marked dry seasons at Colombo, centred in February and August, respectively, *i.e.*, after the rainy seasons which usher in the north-east and south-west monsoons have died away, and steady monsoon winds prevail in the neighbourhood of Ceylon. The former dry season usually gives the more severe droughts. The year 1929, which has furnished a number of new records in the weather of Great Britain, has provided at least one at Colombo, for the south-west monsoon drought of 1929 can fairly be described as the worst, for that season of the year, since rainfall observations were started. It has, however, often been exceeded in severity during the other dry season.

The *British Rainfall* definitions of drought are:—*Absolute drought*, any period of at least 15 consecutive days, to none of which is credited ·01in. of rain or more; *partial drought*, any period of at least 29 consecutive days, the mean daily rainfall of which does not exceed ·01in.; *dry spell*, any period of at least 15 consecutive days, to none of which is credited ·04in. of rain or more. At the Observatory in Cinnamon Gardens, no rain fell for 32 days, July 22nd-August 22nd, while there was a partial drought of 54 days, July 10th-September 1st, with a total fall of 0·45in. and a dry spell of 36 days, July 18th-August 22nd; the next highest figures, since 1908, for south-west monsoon droughts being 29, 39 and 29 days respectively. At the Fort, corresponding figures for the roof gauge there, when corrected to ground values, are 30, 53 (with 0·42in.), and 30, while the highest figures, excluding these, since 1870, for the same class of drought, are 29, 45 and 33 days respectively (roof or corrected ground readings).

The liability to rain or drought changes so rapidly from place to place in Ceylon, owing to the nature of the factors on which its climate depends, that absolute comparisons of rain, or the lack of it, at different stations would give no real information about this drought. For example, Chilaw, Puttalam and Tabbowa, 50 to 80 miles north of Colombo, showed much greater drought at that time. These stations, however, are on the borders of the dry zone, which suffers almost a permanent drought during the south-west monsoon, and their figures for this drought cannot be regarded as, comparatively, very high. Again, at Kalutara, on the coast about 30 miles south of Colombo, although the figures registered, absolute drought 26, partial drought 41, and dry spell 26 days, are distinctly less than those at Colombo, compared with past records they seem quite as outstanding. Although Kalutara showed fairly high figures for the drought, at Neboda, only 8 miles inland from

it, but among the foot-hills, the lack of rain did not even reach the status of a drought.

A better method is to compare the actual rainfall with the average. As the drought at Colombo lasted over two-thirds of July and the whole of August, I expressed the total rain falling in those two months as a percentage of the average total for July and August together, for about 130 stations, fairly well distributed over the island, all of which had averages of at least 10 years.



RAINFALL OVER CEYLON, JULY AND AUGUST, 1929, EXPRESSED AS A PERCENTAGE OF THE AVERAGE.

The general grouping of these percentages is given in the figure. It shows that the total rainfall over the two months was in deficit over practically the whole island, the only exceptions, among the stations examined, being a few in the Trincomalee district, and one station, Rotawena, near the south-east coast, the latter standing out in marked contrast to neighbouring gauges. In the south-west of the island, the low-country districts showed generally about 40 per cent. of average, the Colombo district with 25-30, giving the lowest figures here, while a coastal strip near Galle showed just over 50 per cent. Up-country gave distinctly higher figures, 50-75 usually, on both the windward and leeward sides of the hills. The north-east coastal districts had the highest percentages, 75 to over 100 per cent., while the north and north-west, and the south-east, had the lowest, a large majority in the north and north-west reporting no rain at all over the two months. The distribution of the figures seems to be roughly symmetrical about a line drawn through the hills, in a direction approximately south-south-west to south-west.

The strength of the monsoon winds over the island was, on the whole, about normal in July, while it was distinctly below at most stations during August. The drought, however, apparently cannot be explained as due to weakness of the monsoon currents here, for the second half of July gave winds of much the same mean strength as the first half, both being about normal. On the south and west coasts, mean dry-bulb temperatures (mean of maximum and minimum) were only slightly above normal, and mean wet-bulb temperatures only slightly below, the mean deviations over the two months, for the group of four stations Puttalam, Colombo, Galle and Hambantota, being + 0·4°F. and − 0·6°F. for dry and wet bulbs respectively, while at the same stations the relative humidities (computed from 9h., 15h., and minimum temperatures), showed, on the whole, practically no change from normal. The drought cannot therefore be explained as due to unusual dryness of the monsoon winds, as far as surface observations are any criterion of this. Taking the island as a whole, the mean direction of the monsoon winds showed no marked deviation from normal, being a trifle west of south-west. It does not seem, therefore, that the drought can be explained in terms of a perceptible change in the general direction of the monsoon drift.

Observations at hill-stations gave no indication of marked deviation from the normal lapse-rate of temperature, the mean temperature offsets from average for low-country stations in the south-west of the island being + 0·3°F. for July and + 0·5°F. for August, while the corresponding offsets for Nuwara Eliya (6,200 ft.) were + 1·2°F. and + 0·7°F., and other hill stations showed similar small offsets, generally positive.

It seems rather remarkable, at first sight, that under steady south-west monsoon conditions in Ceylon, roughly June to September, inclusive, there should be such uniformity in many basic meteorological factors, wind, temperature, humidity, pressure gradient, over the different months, and yet such variations in the orographical rainfall in the south-west of the island. For example, the June and August mean monthly totals are 8·4 and 2·9 in. at Colombo, 18·0 and 9·4 at Avisawella (inland low-country) and 23·6 and 16·0 at Hatton (up-country). The monsoon currents approaching Ceylon must tend to form paths for themselves around the island and, more particularly, around the hills, and a possible explanation of these variations in the rainfall is that they are due to variations in the facility with which such stream-lines can be formed or maintained. The mean wind directions at Ceylon coast stations give distinct evidence of the presence of these stream-lines. Of these stations Galle, owing to its geographical position, shows the greatest deviation from the normal south-west direction of the monsoon winds, to a mean direction roughly west-north-west, and the mean monthly deviation is greatest in July and August, when

the mean monsoon rainfall in the south-west of the island is distinctly less than in June or September.

Now the maintenance of these stream-lines will depend on the weather in adjacent regions. Depressions or other disturbances will tend to break them up, and force the air currents to rise over the obstacles in their path, instead of going round them, and the rainfall will increase. It is when the front of the monsoon, where such disturbances are most frequent, is farthest north, that least monsoon rain falls in the south-west of the island.

If this argument is correct, the unusual drought of July and August, 1929, can be explained, as far as the windward side of the island is concerned, on the hypothesis that the stream-lines formed then were even less affected than usual, by weather disturbances in adjacent regions. So much of the neighbourhood is sea, in which meteorological observations are scanty, that it is hardly possible to test this hypothesis directly, by a consideration of the general weather conditions near Ceylon. That the drought was roughly symmetrical with respect to the hills, and in a direction not far removed from the normal direction of the winds, is consistent with this explanation, though also not inconsistent with others.

Wind directions at individual stations give no clear indication of greater avoidance, at that time, of the obstacle of the hills. The observations, however, are few (twice a day, at 9h. 30m. and 15h. 30m.); moreover, it is possible that, even in a wet monsoon, the amount of rain that actually falls is only a small fraction of what could fall, if all the air went straight ahead over the obstacles in front of it, so that comparatively small deviations from the mean behaviour of the stream-lines might make a large difference in the amount of rain or drought.

The rainfall on the leeward side of Ceylon during this monsoon is mainly due to afternoon or evening thunderstorms, the result of local circulations (sea-breezes or mountain winds). The rainfall should therefore depend partly on the area of the wind-shadow caused by the hills, and the distance to which it extends out at sea, while other relevant factors are the humidity of the air in this wind-shadow, and the clearness of the sky above it in the early part of the day. Data about these factors are too scanty to make it worth while attempting any discussion of the 1929 drought in the east of Ceylon.

Figures for July and August from the stations given in the *Indian Monthly Weather Report* show that the drought did not extend up the Malabar coast, which, on the whole, received about the normal rainfall for the period July-August. The country to leeward of the Ghauts and Cardamum Hills, however, was generally in deficit, which was most marked on the Indian side of the Gulf of Mannar, where percentage rainfalls as small as those on the Ceylon side were obtained.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, March 18th, at 49, Cromwell Road, South Kensington, Professor S. Chapman, F.R.S., Vice-President, in the Chair. As is customary in March, the meeting took the form of a lecture (The Symons Memorial Lecture), which was delivered on this occasion by Commander E. C. Shankland, R.N.R., his subject being:

Navigation from the Viking Period to the Present Day in Relation to Science and Meteorology.

Commander Shankland sketched the probable ideas which lay at the back of the Vikings' schemes for voyaging first westward, then south-westward, and finally making voyages over 2,000 miles, even reaching Luna in Italy by sea through the Mediterranean. The information of climatic conditions existing at the ninth century which we possess from reference to early literature provides an interesting possibility that this was a dry period, and that parts of Greenland now perennially ice covered, were dry and open for exploration. This may have induced the Vikings to venture afield to some remote places overseas. So much of the world's navigation history has been made and adventure commenced in the North Atlantic—either from the British Isles, Scandinavian or Continental seaports—that the use of an elementary sextant to maintain the measurement of latitude by polar star was, in the lecturer's opinion, used prior to the compass or lode stone in Europe. The polar star would not only be a sensitive measurement for latitude but also a meridional bearing for the voyages. The lecturer showed by a projection of the hemisphere having England as the centre, that it contains all the habitable globe except Australia and a small portion of South America. No other hemisphere can be contrived upon the earth having so great a proportion of land concentric to a chosen point as this. Cargoes carried by ships are the product of the land, and any port enjoying trading facilities and relations with the more habitable portions of the earth must be at an advantage if centrally situated. The want of local knowledge of the weather in the North Sea and Irish Sea was probably the greatest meteorological event in our history, as it contributed the loss of the Spanish Armada and so gave Great Britain the freedom of the seas. Matters such as the Gulf Stream and the many weather fallacies which surround the subject were touched upon. Among modern practices the wind pressure on ships, the utility of the barometer in gauging the lifting power of salvage pumps in salvage operations were explained. Ice navigation, fog signals, lights, and their allied meteorological features were also dealt with. Weather warnings, the life-boat service and also the winds and passages of the China Clippers in the 'sixties were described with numerous slides and references.

Correspondence

To the Editor, *The Meteorological Magazine.*

Barbados Rainfall from 1850 to 1930

Records are available from a sufficiently large number of stations throughout the island from 1850 to furnish data for comparison.

The island's rainfall for the eighty-one years from 1850 to 1930 somewhat strikingly divides itself into three periods of twenty-seven years each. The first and last periods are relatively dry, and the middle period relatively wet.

The mean annual rainfall of the island for the entire period, 1850 to 1930, is 60·07in., that for the three periods, 1850-1876, 1877-1903 and 1904-1930, is respectively 57·38in., 68·51in., and 54·31in.

Comparing the island's rainfall of each individual year in each period with the average annual rainfall of the entire period it is observed that during the first period (1850-1876) the annual rainfall exceeds the average in 8 years and is less than the average in 19 years; during the middle period (1877-1903) the annual rainfall exceeds the average in 20 years and is less than the average in 7 years; and during the last period (1904-1930) the annual rainfall exceeds the average in 6 years and is less than the average in 21 years.

Examining the amounts of the annual rainfall during the last period (1904-1930), it is observed that the years in which the average is much exceeded are 1906, 1915, 1918 and 1927, and only once in the last twelve years (1919-1930), namely in 1927, by the small margin of 3·69in., has the average been exceeded.

The three wettest years during the entire period (1850-1930) were 1901, 1896 and 1892 with annual amounts, representing the mean of more than 150 stations in each year, of 91·89in., 89·68in., and 86·46in., respectively. The three driest years in the same period were 1930, 1921 and 1912 with annual amounts of 38·95in., 40·72in., and 41·49in., respectively.

The year 1930 has been remarkable for the inequality of the distribution of rainfall throughout the island and also within very small areas of the island. It is noteworthy that the total rainfall for 1930 at individual stations ranges from 40 to nearly 90 per cent. of the average for the forty-year period, 1890-1929.

C. E. Skeete.

Dept. of Agriculture, Barbados, West Indies. March, 1931.

Arc of Contact and "Mock Suns"

Whilst on duty on the morning of February 24th, 1931, I observed at 9h. the "arc of contact" of the halo at 46°. It was situated in what appeared to be a perfectly cloudless portion of the sky (due no doubt to particularly fine ice-fog) and was of brilliant colouring, showing red, yellow, green and blue.

At 9h. 15m. a " mock sun " appeared to the right of the sun, and at 9h. 22m. one to the left also. The former was exceedingly fine, showing all colours from red nearest the sun to a purple tinge on the outside. That of the left-hand side was less distinct. (See figure forming part of the frontispiece of this number of the magazine.)

These phenomena remained " on view " until 9h. 45m., then faded rapidly. The remarkable thing was, that, during the whole period no trace was visible of the halo of 22°.

Particulars of weather, etc., were as follows:—Wind SW. light. Cloud 5/10th cirro-stratus and fine cirrus all on the sun's level and 1/10th alto-stratus low on the horizon. Visibility 4 miles. Sun's altitude 17°. " Arc of contact " 47° from the sun. The " mock suns " 23° from the sun on either side. Angular measurements were made with a theodolite.

CYRIL A. JUPP.

R.A.F. Station, Upper Heyford, Oxford. February 25th, 1931.

NOTES AND QUERIES

Floods in Arabia and the Western Desert of Egypt, December, 1930

In the *Meteorological Magazine* for March, 1931, was published an article by Mr. L. J. Sutton on " Exceptional rain in the Libyan Desert," December 28th to 30th, 1930. Subsequently the area of heavy rainfall extended further to the eastward, and in response to an inquiry Capt. J. Durward, Superintendent of the Meteorological Section, Middle East Area, received the following information:—

" Heavy rain fell over the whole region Akaba and Gueira on December 29th, 1930, beginning after 15h. 30m. G.M.T. Floods swept away the wall round Akaba, locally called Essadd, many houses fell and considerable damage to property was caused. There were three casualties, two children killed and one man injured. Nearly 100 head of cattle were swept away by the flood. Rain lasted on and off the whole night."

Capt. Durward adds the following comments:—

" On December 28th at 6h. G.M.T. a depression was situated near Crete, with an ill-defined secondary over the Western Desert. During the ensuing 24 hours the secondary moved across Egypt and at 6h. G.M.T. on the 29th it was centered over Sinai. This depression had well-marked warm and cold fronts; for example, in the warm air the temperature at Tor was 81°F. and in the cold air at Ismailia, Heliopolis and Assuit it was about 60°F. The cold front reached Ramleh (Palestine) about 11h. G.M.T. and Amman (Transjordan) about 14h. G.M.T. on December 29th. The air over the whole of Lower Egypt, Palestine and Transjordan was therefore cold air which had crossed the Mediterranean and was in consequence relatively damp.

Meantime the main depression near Crete on the 28th had moved south-eastwards, being centered near Sollum on the 29th, and a supply of still colder air had invaded Western Egypt (for example, at 6h. G.M.T. on the 29th the temperature at Siwa is 13°F. less than at Matruh). The effect of this new supply of cold air was to force the already damp air upwards and cause rain, which was very heavy in the Western Desert, but not very heavy further east in the Cairo and Canal zone.

Some of the rain which fell in Transjordan on the 29th may have been caused by the forced elevation of very warm air from the Red Sea, but most of it was due to the same conditions as caused the rain in the Western Desert on the 28th and 29th. At Ramleh, for example, the heaviest rain fell between 2h. 30m. and 4h. 30m. G.M.T. on the 30th, which is about 16 hours after the passage of the first cold front. The rainfall at Amman up to 6h. G.M.T. on December 30th was only about 4mm. Ma'an reported 10mm., so that the rainfall on the slopes of the wady carrying the Ma'an-Akaba road may have been heavier still. In any case it was sufficient to convert the dried-up river bed into 'a torrent six feet deep.' "

The Deepening of Depressions by Day and Night

In the *Meteorological Magazine* for March, 1931, on pp. 39-41, there appears a note by Mr. C. K. M. Douglas on " The Deepening of Depressions by Day and Night." The following remarks extracted from the conclusions reached in two papers by the present writer (one published four years ago,* the other at present in the press†) are of interest in the same connexion. In the first the conclusion is reached that " at least over the British Isles, phenomena of the warm front and cold front descriptions either show preferences, as to the times of their occurrence, for certain periods, or are more conspicuous when they pass within these periods." In the second paper, amongst other conclusions there are the following, " the rainfalls occurring at warm fronts and cold fronts have characteristic semi-diurnal variations of very considerable amplitude, variations which are much more marked than those in rainfall occurring in homogeneous equatorial or polar currents. The variations are in neither case symmetrically semi-diurnal, but if one averages up the two types of rainfall the times of maxima correspond roughly to those of minima of barometric pressure and *vice versa* in the average semi-diurnal variation of pressure. If the resonance theory of the semi-diurnal oscillation of pressure be accepted, there is some difficulty in seeing why the normal pressure variation should be associated so markedly with the variations of rainfall in the

**Edinburgh, Proc. R. Soc.*, XLVII 1927, pp. 326-58.
†London Meteor. Office, Geophys. Mem. No. 53.

locality of discontinuities and less so, if at all, with the rainfall of days which are subject to less disturbance of a local character."

As a result of comparison between sets of data dealt with in the two papers it is noted that—(1) the pressure variation (reversed) on bright days of equatorial air resembles the variation of rainfall on cold front days, and (2) the pressure variation (reversed) on cloudy days of equatorial air resembles the variation of rainfall on warm front days.

And it is finally concluded that the diurnal variation in the rainfall at fronts is controlled primarily—

"(*a*) in the case of cold fronts by the working of insolation and radiation on the more or less clear warm sector in advance of or above the front; and

"(*b*) in the case of warm fronts by the corresponding effects of insolation and radiation on the warm air above the upsliding surface."

In another part of the second paper it is remarked that "it is inevitable that the diurnal processes besides affecting the rainfall, affect the behaviour and subsequent history of the depression; that is, the working of the diurnal events may lead to occlusion of the warm sector and the formation of secondaries or, on the other hand, may lead to a broadening of the warm sector and the deepening or increasing of the speed of propagation of the depression."

Whilst it has not yet been possible to explore fully this last aspect of the question, it will be seen that the feeling of the present writer is that diurnal behaviour of depressions is probably too complicated a matter to be summed up simply by a greater readiness with which they deepen by night, though that must be regarded as a fact applicable to a considerable majority of cases.

The conclusion that a controlling part in the behaviour of both cold and warm fronts lies with the working of the diurnal processes on the warm air is not opposed to the view of Mr. Douglas that the true cause of the more ready deepening of depressions by night lies in the upper air.

A. H. R. Goldie.

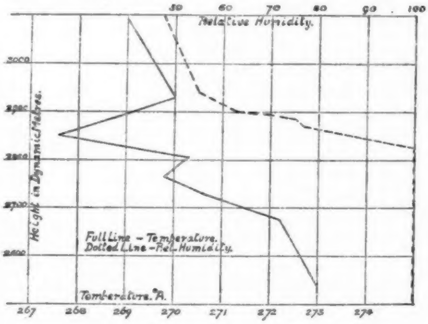
Remarkable Temperature Lapse Rate

A sounding with a registering balloon carrying a meteorograph of the Dines pattern, made from Kew Observatory at 18h. G.M.T. on September 13th, 1930, yielded an unusual record at a height of about 3 kilometres.

The diagram shows an enlarged graph of temperature and relative humidity against height, or more strictly geopotential. For those not familiar with the unit employed it may be stated

that 3,000 on the graph corresponds with a height of 3,060 metres, and so on in proportion.

A slight shower of rain fell about 7 minutes before the sounding balloon was released, and at the time of the start the sky was nearly covered with cumulus and strato-cumulus clouds.



Upper air temperature at Kew Observatory on Sept. 13th, 1930.

An examination of the graph shows a series of exceedingly sudden changes in the lapse rate, combined with a very sudden fall of the relative humidity from a previous state of saturation. The air above 3,000m. was very dry, while both above and below the region considered the lapse rate had a value of about 6° per 1,000m. The salient point to notice is the very rapid fall of temperature between 2,810m. and 2,850m., amounting to a lapse rate of about 50° per 1,000m., combined with a very sudden fall of relative humidity at the same point. Above is a rapid rise of temperature up to 2,930m.

The most probable explanation seems to be that the balloon rose through the centre of a cumulus cloud, and that it emerged from the top at about 2,800m., probably the very cloud which caused the shower a few minutes before the start of the sounding. If the sharply defined hump of saturated air at the top of an active cumulus cloud be rising upwards, there must be just above it a layer of drier air in process of being borne upwards. The temperature of this layer must be lower than that of the saturated air below on account of the difference between the adiabatic lapse rates for saturated and unsaturated air. This layer must also be cooler than the undisturbed air at the same level, unless the general lapse rate be equal to the dry adiabatic rate, which on this occasion there is no evidence was the case. Hence the cold layer will continually slide off the hump and will not be of great thickness.

Such a hypothesis fits in well with the temperature changes shown on the graph; the zigzag at 2,800m. suggests a region of turbulence at the top of the hump, which is not an improbable thing. It is not perhaps wise to attach too much importance to the precise point at which the humidity began to fall; the hygrograph is somewhat sluggish, and the whole sequence of changes of temperature must have taken place within about a

minute, working from the known approximate rate of ascent of the balloon. The rate of change of relative humidity shown is much greater than is ordinarily observed in upper air soundings, and indicates some unusual discontinuity.

L. H. G. DINES.

Warm Front Fog

Although fog along the south-west coasts of the British Isles is by no means an uncommon feature when an air-mass associated with a depression spreads to more northerly latitudes, it is usually preceded by a well-marked belt of rain, low-lying cloud and falling pressure. The arrival of the warmer air-mass originating in sub-tropical latitudes is shown on many occasions by a belt of fog stretching sometimes over a large area of sea and coast. Observations from ships often show the presence of the fog some hours before the warmer air reaches the British coasts, and such observations form one of the safest guides in identifying and locating the warm front of a depression. A fog of short duration occurred at Plymouth on November 7th, 1930, associated with the arrival of such an air-mass, but of which very little warning could be given from an examination of synoptic charts.

A shallow occluded depression travelled north-east over the Faeroes during the night November 6th-7th. The remains of its warm sector were indicated over the British Isles at 7 a.m. on November 7th by slight discontinuities in wind direction, while rain (reported as a shower) occurred over the Scilly Isles between 6 and 7 a.m. as the warm front passed. The succession of events at Plymouth is indicated by the following notes supplied by the Meteorological Station at Mount Batten :—

"The visibility during the morning was very variable. Patches of haze diminished the visibility in some directions at 7 a.m. to 2,000 yards, while in other directions it was very good. By 9.30 a.m. the visibility had decreased a good deal towards the land and by 10 a.m. was 700 yards. It was a "thin" fog, the visibility seawards, *i.e.*, south to south-west, being three miles and to the south-east about five miles.

"Between 7 a.m. and 1 p.m. the clouds were of strato-cumulus type, 8/10 to 9/10 of the sky being covered, with the cloud base at about 2,000 feet. The wind was light from NE. at 7 a.m., dropping to a calm at 9.45 a.m., with puffs from a westerly point. Between 7 a.m. and 10 a.m. the temperature rose 8°F to 43°F. and was still rising rapidly at that time, 53°F. being measured at 1 p.m. Pressure changes were very small, the barometer being almost steady after a rise.

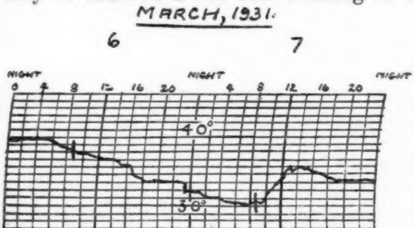
"Slight drizzle occurred at 9.40 a.m. and the fog finally cleared about 10.30 a.m."

The succession of events may be explained by supposing that at 7 a.m. there was a gravitational flow of air from the neighbouring high ground, the air having been cooled by radiation and the flow seawards was assisted by the higher temperature of the sea compared with the land. The air flowing down the valleys into the different channels in Plymouth Harbour would be broken into several streams and this would account for the visibility varying so much in different directions. Mixing would occur between the new air mass and the air mass being displaced, thus producing condensation as shown by the drizzle and fog, The fog would disperse as the air temperature rose and the gravitational flow or air cased." R. S. READ.

Cooling by Evaporation

The dry easterly winds of Friday and Saturday, March 6th and 7th, provided an interesting example of freezing by evaporation in Fountain Court, London, E.C.4. A tree grows near the fountain and at times spray falls over its lower branches.

At midday on the 6th these branches were covered with a thin layer of ice, although the air temperature was above freezing point; the appearance of the twigs was similar to that shown in the illustration on page 53 (Plate III) of the *Meteorological Observer's Handbook*. The temperature on the Air Ministry roof at the time (1 p.m.) was 35·7°F., and the reading of the dry bulb at Kew was 35°F. No wet bulb reading was taken, but the humidity by the hair hygrograph was 54 per cent., from which may be deduced a wet bulb reading of 30°F.



TEMPERATURE AT ST. JAMES' PARK.

To fix more clearly how the ice coating was formed the tree was examined at 9 a.m. on the 7th, and the twigs were perfectly dry and free from ice or frost in any form, although the temperature was 29°F.; the ice coating of the day before had evaporated after the fountain ceased playing at 4 p.m. The fountain recommenced at 11 a.m., by which time the temperature had risen to 32°F., and by 1 p.m. the tree was a delightful sight; thick, clear, shining ice, glistening in the sunshine, covered every twig on the nearer side of the tree.

The 1 p.m. temperature readings on the 7th were, at the Air Ministry, 34°F. and at Kew Observatory 33°F. From the hair hygrograph reading of 47 per cent. the deduced wet-bulb reading

was 28°F. The nearest thermograph at 4ft. above ground level is in St. James' Park, and the record shows that the temperature of the air was above the freezing point from 11 a.m.-4 p.m. both on 6th and 7th. During the 6th temperature fell continuously from 39°F. at 4 a.m. to 32°F. at midnight.

The photograph forming part of the frontispiece of this number of the magazine which was taken at 1.20 p.m. on the 7th gives an impression of the effect but lacks the desired definition.

R. M. POULTER.

Review

Medidas definidas de la presión atmosférica. By G. Koschmeider. (Madrid, Anales de la Sociedad Española de Meteorologia. Vol. III, No. 4, 1929, pp. 98—105.)

G. v. Elsner has shown that the values of atmospheric pressure at a mountain station reduced to the level of a lower station generally appear too low, the discrepancy varying according to the wind velocity. Thus, on the Schneekoppe (1610·5m.) with a wind of force 10 the pressure reduced to 396·8m. is too low by an average amount of 2·5mm., but with a wind of force 5 the discrepancy is only 0·1mm. Dr. Koschmeider shows that this difference is due to the dynamical effect of the wind in reducing the pressure, and divides it into two parts, the effect of the building in which the barometer is housed, and the effect of the topography of the mountain summit. He shows that about the round tower of Göttingen the distribution of pressure agrees fairly well with the theoretical distribution about an infinite cylinder; the total effect is a diminution of pressure, and this is communicated through windows to the interior of the tower where it affects the reading of the barometer.

To separate this "edifice effect" from the topography effect, experiments were carried out at the observatory on the Schneekoppe. The pressure inside the building was given by a barograph, that on the summit away from the building by a manometer connected to an orifice in a plate level with the ground at least 25 metres away. The undisturbed pressure (*i.e.*, excluding both topography and edifice effects) was given by the manometer when the wind fell below 12m/s. The edifice effect at high wind velocities closely resembled the theoretical effect on the interior of an infinite cylinder in free communication with the exterior on all sides, and reached 2mm. with a wind velocity of 30m/s. The topography effect on the windward side of the summit was represented closely at velocities exceeding 16m/s., by the equation $\delta p = 0{\cdot}0033\ v^2$ (v in m/s., p in mm. of mercury). The two were not additive, the edifice effect occurring with winds between WSW. and NNW., the topography effect with winds between S. and SW.

This is a paper of considerable interest, calling attention to a source of error which may be important in synoptic meteorology.

Books Received

Falmouth Observatory. Meteorological Notes and Tables for the year 1929, also Table of the mean magnetic declination at Falmouth from 1888 to 1930 by W. T. Hooper. Falmouth, 1930.

Natürliche und künstliche Strahlungen. By Dr. W. Mörikofer (reprinted from Die Medizinische Welt No. 13).

News in Brief

During March the mean minimum temperature at Ross-on-Wye was below normal for the first time since September, 1929 (except February, 1930, when it was 0·2°F. below normal), a period of 18 months.

Dr. J. Keranen has succeeded Prof. G. Melander as Director (interim) of the Finnish Meteorological Service.

Dr. J. Lugeon has succeeded Prof. S. Hlasek as Director of the Polish Meteorological Service.

The following telegram, dated Cape Town, April 8th, and addressed Capt. Entwistle, Air Ministry, London, has been received in the Meteorological Office from Lt.-Commander Glen Kidston on the completion of his flight from England: "My sincere thanks your valuable co-operation without which my successful attempt on record would not have been possible (signed) Glen Kidston."

On March 31st two members of the staff of the Meteorological Office retired. Miss R. E. Smith joined the Office in 1891 and worked first in the Marine Division and later in the Library, where she was well known as the custodian of the lantern slides. Mr. A. E. Pycock joined the Office in 1887 and worked mainly in the Climatological Division, especially on the preparation of the *Weekly Weather Report.* Previous to 1887 he had spent 7 years with the Royal Meteorological Society and thus has completed 50 years' work in meteorology. A large gathering of past and present members of the staff met in the library at 5.30 p.m., when presentations were made by the Director on their behalf to Miss Smith and Mr. Pycock in recognition of their long and valued services.

The Weather of March, 1931

Pressure was below normal over the eastern United States, most of the North Atlantic, southern Europe and Russia, the greatest deficits being 16·6mb. at Horta and 6·8mb. at Moscow. Pressure was above normal over the western United States, Canada, Greenland, Spitsbergen, north-west Europe and Germany, the greatest

excesses being 11·6mb. at 60°N., 60°W. and 11·1mb. at Thorshavn. On the Baltic and Bothnia Seas pressure was normal. Temperature was mainly above normal in south-west Europe, northern Scandinavia and Spitsbergen, but below normal in southern Scandinavia and central Europe. Rainfall was generally in excess in central Europe and northern Norway and deficient in Spitsbergen and Sweden, one of the greatest deficits being 24 per cent. of the normal at Bohuslaen, Sweden.

Easterly winds and, except in Ireland and south-west England, dry and sunny conditions were the salient features of the weather of March over the British Isles. The first fortnight was cold in the east and north, with an exceptionally cold spell in the south-east from the 6th to 10th, while in the south-west it was warm and unsettled until the 6th and cold from then to the 10th. During this first warm spell in the south-west rainfall was heavy; 2·13in. occurred at Kilmacthomas (Co. Waterford) and 2·06in. at Glanmire (Co. Cork) on the 5th, and 1·34in. at Bodmin (Cornwall) on the 3rd. In the east and north snow fell heavily on the 1st and 2nd in Scotland and north-east England and slightly in south-east England. By the 4th cold south-easterly winds had set in. These gradually backed to east and spread over the whole country, and then on the 9th and 10th to north-east, when the coldest weather was experienced in south-east England. Snow fell heavily at times during this period,* but there were many long sunny intervals. The 12th and 14th were both sunny days, Clacton having as much as 10·4hrs. bright sunshine on the 12th. By the 11th, the snow had melted from the south but continued in the north until the 15th. From the 13th there was a gradual rise of temperature which extended to Scotland after the 16th as the winds came from a more southerly source. Temperature was highest on the 20th, when 69°F. was reached at Greenwich and Cardington, 67°F. at Tottenham and Cardiff, and 66°F. at Southport, Manchester and Morecambe, and the sunniest days of this period were the 15th, 17th and 18th. Aspatria had 10·6hrs. on the 18th. On the 22nd an anticyclone moved south-east over the British Isles and a period of quiet, mainly dry, weather followed, with fairly warm days and cold nights. Except in the extreme south-west pressure continued high and the weather dry but colder until the end of the month, with much sun on the 25th to 27th; 11·7hrs. were reported from Aberystwyth on the 27th. The extreme south-west, however, came under the influence of a large depression over the Atlantic about the 27th, and unsettled conditions prevailed there with much rain at times. 1·65in. fell at Dunmanway (Co. Cork) and 1·00in. at St. Austell (Cornwall) on the 31st. The distribution of bright sunshine for the month was as follows:—

* See page 53.

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	147	+ 42	Liverpool	133	+25
Aberdeen	107	— 10	Ross-on-Wye	135	+19
Dublin	109	— 14	Falmouth	89	—49
Birr Castle	98	— 12	Gorleston	164	+29
Valentia	91	— 32	Kew	123	+18

The special message from Brazil states that the rainfall in all regions was scarce being 0·31in., 0·28in. and 1·02in. below normal in the northern, central and southern regions respectively. Five anticyclones passed across the country and the continental depression was active. Crops were generally in good condition and the weather favourable for the harvest. At Rio de Janeiro pressure was 0·6mb. below normal and temperature 0·2°F. below normal.

Miscellaneous notes on weather abroad culled from various sources. Unusually cold weather set in on the 1st in the Naples districts, and the surrounding mountains were covered with snow. Floods were experienced on the Seine from near the beginning of the month until about the 16th. On the 9th a severe snowstorm was experienced over most of Switzerland, and was followed by a thaw on the 13th which caused widespread avalanches and landslips. (*The Times*, March 3rd-25th.)

A hurricane was raging in the neighbourhood of Mauritius from the 4th to 6th and much damage was done to the sugar-cane crop. (*The Times*, March 6th-10th, 21st.)

Another hurricane passed over the Fiji Islands on the 2nd, accompanied by torrential rains which caused further floods. (*The Times*, March 3rd.)

Severe storms were experienced on the Atlantic early in the month. Storms and exceptionally high tides occurred along the Atlantic coast of the United States on the 4th. Heavy snowstorms were experienced in Canada and the Middle West on the 7th and 8th, while heavy gales and torrential rain swept New York and New Jersey on the 8th. (*The Times*, March 6th and 10th.) In the United States temperature was slightly below normal in the eastern districts, but above normal in the western, where it was as much as 15°F. above normal at Miles City and Havre for the week ending the 24th. In the Argentine the weather was abnormally warm for the time of year at the beginning of the month. (Washington, U.S. Dept. Agric., Weekly Weather and Crop Bulletin.)

Rainfall, March, 1931—General Distribution

England and Wales	36	per cent of the average 1881-1915.
Scotland	42	
Ireland	101	
British Isles	51	

Rainfall: March, 1931 : England and Wales

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond	Camden Square	·23	13	*Rut*	Ridlington	·17	10
Sur	Reigate, Alvington	·34	15	*Linc*	Boston, Skirbeck	·35	22
Kent	Tenterden, Ashenden	·34	16	,,	Cranwell Aerodrome	·30	21
,,	Folkestone, Boro. San.	·57	...	,,	Skegness, Marine Gdns	·27	16
,,	Margate, Cliftonville	·15	9	,,	Louth, Westgate	·54	25
,,	Sevenoaks, Speldhurst	·50	...	,,	Brigg, Wrawby St.	·43	...
Sus	Patching Farm	·87	40	*Notts*	Worksop, Hodsock	·32	19
,,	Brighton, Old Steyne	·41	20	*Derby*	Derby, L. M. & S. Rly.	·10	6
,,	Heathfield, Barklye	·56	22	,,	Buxton, Devon Hos.	·24	6
Hants	Ventnor, Roy. Nat. Hos.	1·25	61	*Ches*	Runcorn, Weston Pt.	·26	13
,,	Fordingbridge, Oaklnds	·92	39	,,	Nantwich, Dorfold Hall	·47	...
,,	Ovington Rectory	·40	15	*Lancs*	Manchester, Whit. Pk.	·31	14
,,	Sherborne St. John	·18	8	,,	Stonyhurst College	·53	14
Berks	Wellington College	·12	6	,,	Southport, Hesketh Pk	·37	17
,,	Newbury, Greenham	·16	7	,,	Lancaster, Strathspey	·52	...
Herts	Welwyn Garden City	·24	...	*Yorks*	Wath-upon-Dearne	·23	13
Bucks	H. Wycombe, Flackwell	·14	...	,,	Bradford, Lister Pk.	·43	18
Oxf	Oxford, Mag. College	·10	7	,,	Oughtershaw Hall	1·31	...
Nor	Pitsford, Sedgebrook	·07	4	,,	Wetherby, Ribston H.	·85	44
,,	Oundle	·31	...	,,	Hull, Pearson Park	·54	30
Beds	Woburn, Crawley Mill	·07	4	,,	Holme-on-Spalding	·96	...
Cam	Cambridge, Bot. Gdns.	·19	13	,,	West Witton, Ivy Ho.	·95	31
Essex	Chelmsford, County Lab	·25	14	,,	Felixkirk, Mt. St. John	1·80	91
,,	Lexden Hill House	·24	...	,,	Pickering, Hungate	1·18	59
Suff	Hawkedon Rectory	·24	13	,,	Scarborough	·73	40
,,	Haughley House	·13	...	,,	Middlesbrough	1·25	80
Norf	Norwich, Eaton	...	...	,,	Baldersdale, Hury Res.	·79	...
,,	Wells, Holkham Hall	...	..	*Durh*	Ushaw College	2·97	135
,,	Little Dunham	·85	44	*Nor*	Newcastle, Town Moor	1·03	49
Wilts	Devizes, Highclere	·45	21	,,	Bellingham, Highgreen	1·70	58
,,	Bishops Cannings	·52	23	,,	Lilburn Tower Gdns.	1·23	46
Dor	Evershot, Melbury Ho.	1·10	37	*Cumb*	Geltsdale	1·30	...
,,	Creech Grange	1·36	48	,,	Carlisle, Scaleby Hall	1·20	49
,,	Shaftesbury, Abbey Ho.	·92	39	,,	Borrowdale, Seathwaite	1·60	14
Devon	Plymouth, The Hoe	2·07	71	,,	Borrowdale, Rosthwaite	1·70	...
,,	Polapit Tamar	2·72	91	,,	Keswick, High Hill	·99	...
,,	Ashburton, Druid Ho.	..	...	*West*	Appleby, Castle Bank	·90	34
,,	Cullompton	1·68	61	*Glam*	Cardiff, Ely P. Stn.	·93	29
,,	Sidmouth, Sidmount	1·48	61	,,	Treherbert, Tynywaun	1·20	...
,,	Filleigh, Castle Hill	1·57	...	*Carm*	Carmarthen Friary	1·22	32
,,	Barnstable. N. Dev. Ath.	2·09	80	,,	Llanwrda	1·34	29
Corn	Redruth, Trewirgie	5·28	147	*Pemb*	Haverfordwest, School	2·20	64
,,	Penzance, Morrab Gdn.	4·37	137	*Card*	Aberystwyth	1·49	...
,,	St. Austell, Trevarna	5·06	147	,,	Cardigan, County Sch.	1·17	...
Soms	Chewton Mendip	1·09	31	*Brec*	Crickhowell, Talymaes	·80	...
,,	Long Ashton	·86	34	*Rad*	Birm W. W. Tyrmynydd	2·18	41
,,	Street, Millfield	·93	45	*Mont*	Lake Vyrnwy	1·17	27
Glos.	Cirencester, Gwynfa	·26	11	*Denb*	Llangynhafal	·54	23
Here	Ross, Birchlea	·47	23	*Mer*	Dolgelly, Bryntirion	1·38	28
,,	Ledbury, Underdown	·30	16	*Carn*	Llandudno	·81	37
Salop	Church Stretton	·40	17	,,	Snowdon, L. Llydaw 9	3·15	...
,,	Shifnal, Hatton Grange	·28	15	*Ang*	Holyhead, Salt Island	1·28	49
Worc	Ombersley, Holt Lock	·13	8	,,	Lligwy	1·02	38
,,	Blockley	·11	...	*Isle of Man*			
War	Birminghm, Edgbaston	·18	9		Douglas, Boro' Cem.	1·01	34
Leics	Thornton Reservoir	·09	5	*Guernsey*			
,,	Belvoir Castle	·31	17		St. Peter P't. Grange Rd.	2·86	116

Erratum for February, Cambridge, Bot. Gdns. for 1·63 \| 127 read 2·11 \| 165.

Rainfall: March, 1931: Scotland and Ireland

Co.	Station	In.	Per cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wigt	Pt. William, Monreith	1·01	35	*Suth*	Loch More, Achfary	1·69	26
,,	New Luce School	1·40	40	*Caith*	Wick	1·17	52
Kirk	Carsphairn, Shiel	1·82	30	*Ork*	Pomona, Deerness	1·99	71
Dumf.	Dumfries, Crichton, R.I	·83	...	*Shet*	Lerwick	·77	25
,,	Eskdalemuir Obs.	1·12	23	*Cork*	Caheragh Rectory	6·54	...
Roxb	Branxholm	1·00	34	,,	Dunmanway Rectory	7·67	156
Selk	Ettrick Manse	·91	18	,,	Ballinacurra	7·10	250
Peeb	West Linton	1·16	...	,,	Glanmire, Lota Lo.	8·16	263
Berk	Marchmont House	1·43	54	*Kerry*	Valentia Obsy	4·79	105
Hadd	North Berwick Res.	1·29	68	,,	Gearahameen	5·40	...
Midl	Edinburgh, Roy. Obs.	1·30	73	,,	Killarney Asylum	3·13	66
Lan	Auchtyfardle	·90	...	,,	Darrynane Abbey	4·43	109
Ayr	Kilmarnock, Agric. C.	1·12	40	*Wat*	Waterford, Brook Lo.	5·05	184
,,	Girvan, Pinmore	1·26	33	*Tip*	Nenagh, Cas. Lough	2·54	81
Renf	Glasgow, Queen's Pk.	1·22	47	,,	Roscrea, Timoney Park	2·84	...
,,	Greenock, Prospect H.	1·76	36	,,	Cashel, Ballinamona	3·52	128
Bute	Rothesay, Ardencraig.	1·82	51	*Lim*	Foynes, Coolnanes	1·91	65
,,	Dougarie Lodge	1·39	...	,,	Castleconnel Rec.	2·37	...
Arg	Ardgour House	1·73	...	*Clare*	Inagh, Mount Callan	4·36	...
,,	Manse of Glenorchy	1·40	...	,,	Broadford, Hurdlest'n.	1·97	...
,,	Oban	1·19	28	*Wexf.*	Gorey, Courtown Ho.	4·21	182
,,	Poltalloch	1·29	34	*Kilk*	Kilkenny Castle	2·65	116
,,	Inveraray Castle	1·65	26	*Wic*	Rathnew, Clonmannon	3·81	...
,,	Islay, Eallabus	1·70	45	*Carl*	Hacketstown Rectory	3·24	116
,,	Mull, Benmore	...	...	*Leix*	Blandsfort House	2·74	105
,,	Tiree	...	...	,,	Mountmellick	2·04	...
Kinr	Loch Leven Sluice	1·17	39	*Off'ly*	Birr Castle	2·11	88
Perth	Loch Dhu	1·95	30	*Kild'r.*	Monasterevin	...	...
,,	Balquhidder, Stronvar	2·10	...	*Dubl*	Dublin, FitzWm. Sq.	1·35	70
,,	Crieff, Strathearn Hyd.	1·22	38	,,	Balbriggan, Ardgillan.	2·19	109
,,	Blair Castle Gardens	·89	34	*Me'th*	Beauparc, St. Cloud	2·96	...
Angus.	Kettins School	1·02	46	,,	Kells, Headfort	2·89	105
,,	Dundee, E. Necropolis	·95	46	*W.M*	Moate, Coolatore	2·43	...
,,	Pearsie House	1·36	...	,,	Mullingar, Belvedere	2·99	111
,,	Montrose, Sunnyside	1·21	58	*Long*	Castle Forbes Gdns	2·53	86
Aber	Braemar, Bank	1·59	53	*Gal*	Ballynahinch Castle	4·76	93
,,	Logie Coldstone Sch.	1·15	44	,,	Galway, Grammar Sch.	2·52	...
,,	Aberdeen, King's Coll.	1·14	47	*Mayo*	Mallaranny	3·64	...
,,	Fyvie Castle	1·37	50	,,	Westport House	2·78	71
Moray.	Gordon Castle	1·05	45	,,	Delphi Lodge	6·45	76
,,	Grantown-on-Spey	...	...	*Sligo*	Markree Obsy	1·81	52
Nairn.	Nairn, Delnies	1·37	73	*Cav'n*	Belturbet, Cloverhill	1·68	61
Inv	Kingussie, The Birches	·90	...	*Ferm*	Enniskillen, Portora	1·54	...
,,	Loch Quoich, Loan	·45	...	*Arm*	Armagh Obsy	1·44	61
,,	Glenquoich	1·14	12	*Down*	Fofanny Reservoir	7·24	...
,,	Inverness, Culduhtel R.	1·01	...	,,	Seaforde	2·47	85
,,	Arisaig, Faire-na-Squir	1·22	..	,,	Donaghadee, C. Stn.	1·21	55
,,	Fort William	·81	...	,,	Banbridge, Milltown	1·23	...
,,	Skye, Dunvegan	1·90	...	*Antr*	Belfast, Cavehill Rd.	1·45	...
R & C	Alness, Ardross Cas.	1·58	49	,,	Glenarm Castle	1·73	...
,,	Ullapool	1·79	43	,,	Ballymena, Harryville	1·93	61
,,	Torridon, Bendamph	·75	10	*Lon*	Londonderry, Creggan	·97	30
,,	Achnashellach	·49	...	*Tyr*	Donaghmore	...	...
,,	Stornoway	1·53	...	,,	Omagh, Edenfel	1·48	47
Suth	Lairg	1·78	57	*D.n*	Malin Head	1·20	...
,,	Tongue	2·10	62	,,	Dunfanaghy	1·29	...
,,	Melvich	1·41	..	,,	Killybegs, Rockmount	1·59	81

Climatological Table for the British Empire, October, 1930.

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (° F.)	TEMPERATURE: Absolute Min. (° F.)	TEMPERATURE: Mean Values Max. (° F.)	TEMPERATURE: Mean Values Min. (° F.)	TEMPERATURE: Mean Values ½ max. and min. (° F.)	TEMPERATURE: Mean Values Diff. from Normal (° F.)	TEMPERATURE: Mean Wet Bulb (° F.)	Relative Humidity (%)	Mean Cloud Am'nt (0—10)	PRECIPITATION: Am'nt (in.)	PRECIPITATION: Diff. from Normal (in.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
London, Kew Obsy.	1011·5	— 2·5	68	31	58·5	45·9	52·2	+ 2·3	47·3	90	6·5	1·07	— 1·63	12	3·7	35
Gibraltar	1018·5	+ 1·3	89	54	78·2	62·1	70·1	+ 4·0	61·9	83	5·0	2·04	— 1·27	5	..	..
Malta	1016·7	+ 0·1	80	53	72·6	63·0	67·8	— 3·1	62·5	75	5·3	2·91	+ 0·04	11	7·8	69
St. Helena	1015·7	+ 1·1	72	52	62·2	54·5	58·3	— 0·5	55·5	94	8·6	1·46	— 0·45	13	..	..
Sierra Leone	1013·3	+ 1·7	89	68	84·8	71·0	77·9	— 2·2	75·5	83	6·8	9·22	— 3·40	21	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1011·1	+ 0·2	94	54	84·9	61·3	73·1	— 1·0	..	55	3·2	0·01	— 1·51	1	..	..
Salisbury, Rhodesia	1009·9	+ 0·3	91	49	84·1	56·7	70·4	— 0·3	54·9	27	1·2	0·02	— 1·12	1	10·2	82
Cape Town	1018·0	+ 0·6	87	45	71·8	54·6	63·2	+ 2·0	57·6	75	4·6	0·58	— 1·07	5	..	..
Johannesburg	1014·1	+ 1·0	86	38	75·1	52·7	63·9	+ 1·2	50·0	40	3·4	0·54	— 2·02	7	9·3	73
Mauritius	1018·1	— 0·1	83	58	79·5	64·0	71·8	— 0·9	67·3	64	5·7	2·99	+ 1·61	8	8·3	66
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	0·38	— 1·30	..	..	..
Calcutta, Alipore Obsy.	1011·1	+ 1·7	93	73	89·8	76·4	83·1	+ 2·4	77·1	87	4·2	1·08	— 3·11	3*	..	..
Bombay	1009·4	— 0·4	96	72	91·0	77·5	84·3	+ 2·0	77·0	82	4·9	2·50	+ 0·83	5*	..	..
Madras	1009·3	+ 0·4	91	72	86·3	74·9	80·6	— 1·7	77·2	89	8·3	28·84	+ 17·12	23*	..	..
Colombo, Ceylon	1010·6	+ 0·3	86	72	84·4	73·9	79·1	— 1·2	76·6	83	8·1	33·38	+ 20·26	26	5·1	43
Hongkong	1014·3	+ 0·7	87	66	81·7	73·1	77·4	+ 0·5	70·5	68	4·5	0·41	— 4·44	1	8·8	76
Sandakan	..	..	92	74	89·9	75·6	82·7	+ 1·2	78·2	77	..	2·30	— 7·70	7	..	..
Sydney, N.S.W.	1017·9	+ 3·0	86	51	70·9	58·0	64·5	+ 1·0	60·5	68	6·7	2·09	— 1·12	12	6·5	50
Melbourne	1017·4	+ 2·7	85	43	70·3	51·4	60·9	+ 3·3	55·2	63	7·5	2·12	— 0·47	10	5·7	43
Adelaide	1017·3	+ 1·3	95	42	75·5	55·2	65·3	+ 3·4	56·3	47	7·1	2·80	+ 1·06	11	7·1	55
Perth, W. Australia	1017·0	+ 0·2	82	46	70·6	52·3	61·5	+ 0·5	55·7	57	4·8	1·97	— 0·21	9	9·2	72
Coolgardie	1015·6	+ 0·4	97	39	77·2	50·2	63·7	+ 0·1	53·6	44	3·3	0·37	— 0·37	3	..	..
Brisbane	1019·4	+ 3·2	89	57	78·6	61·5	70·1	+ 0·3	63·8	60	6·3	1·97	— 0·60	12	8·1	63
Hobart, Tasmania	1014·6	+ 4·0	83	40	65·2	48·6	56·9	+ 2·9	50·9	62	6·3	1·64	— 0·62	11	6·3	48
Wellington, N.Z.	1010·5	— 2·6	65	38	56·7	44·2	50·5	— 3·8	47·7	73	7·5	1·35	— 2·73	14	6·0	45
Suva, Fiji	1015·3	+ 2·1	86	62	80·3	69·3	74·8	— 1·2	69·3	70	6·9	0·83	— 6·97	13	5·5	44
Apia, Samoa	1011·2	— 0·3	87	72	84·5	75·6	80·1	+ 1·7	77·2	77	6·2	3·85	— 2·21	11	6·8	55
Kingston, Jamaica	1011·8	+ 0·3	91	70	86·5	72·7	79·6	— 0·9	71·9	88	4·9	3·44	— 4·02	11	..	..
Grenada, W.I.	1013·3	+ 2·7	89	72	86·9	73·8	80·3	+ 0·2	73·8	77	4·8	6·17	— 1·48	20	..	..
Toronto	1019·0	+ 1·0	75	27	56·3	41·7	49·0	+ 2·1	43·5	84	4·7	1·87	— 0·59	10	4·6	41
Winnipeg	1015·9	+ 0·6	60	16	45·9	31·9	38·9	— 1·9	..	..	7·7	3·01	+ 1·58	11	2·9	27
St. John, N.B.	1012·2	— 4·3	84	30	56·8	42·8	49·8	+ 4·5	44·9	77	7·0	3·72	— 0·82	11	4·7	43
Victoria, B.C.	1017·8	+ 0·2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47·4	[illegible]	[illegible]	[illegible]	+ [illegible]	15	4·1	38

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.